Saskatchewan Agriculture and Food

# Flea Beetle Management for Canola, Rapeseed and Mustard in the Northern Great Plains

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*Figure 1. Flea beetle on canola seedling*

The ability of flea beetles to maintain large over-wintering populations has made them persistent spring pests of mustard and Argentine (Brassica napus L.) and Polish (Brassica rapa L.) canola and rapeseed.

Flea beetles feed on plants belonging to the mustard family (Cruciferae) grown throughout the Northern Great Plains of North America (North Dakota, South Dakota, Montana, and Northwestern Minnesota, Manitoba, Saskatchewan, Alberta, and the Peace River District of British Columbia). Eight flea beetle species are known to attack canola, mustard, and rapeseed. Of these, only the crucifer flea beetle, *Phyllotreta cruciferae* (Goeze) and the striped flea beetle, *Phyllotreta striolata* (F.), which were both introduced from Eurasia, are significant pests.

The economic impact of flea beetles on crop production varies with population densities. Yield losses of about 10 per cent are common where flea beetles are abundant, even when the crop is protected with insecticides. A one per cent yield reduction per acre results in a total crop loss of about $25 - $35 million. Annual crop losses in North America from flea beetles probably exceed $300 million.

## Feeding Damage

Flea beetles feed on the cotyledons, leaves, apical bud tissue, petioles, stems, roots and seed pods of crucifers (e.g. canola, mustard, and rapeseed). The effect of the feeding activity on crop development varies with the part of the plant fed on, crop development, growing conditions and the intensity of the attack.

Adult beetles feed on the surface of leaves, stems and seed pods and produce small pits. The tissue underneath the injury eventually withers and dies. On leaves and cotyledons, the damaged tissue breaks up and falls out, producing a shot like hole appearance. Heavy infestations may severely damage cotyledons, first leaves, petioles, and stems. The crop can usually compensate for the destruction of individual plants, provided large portions of the crop are not totally destroyed. Feeding damage is most severe when beetles attack the growing point (meristem) because it limits the ability of the plant to compensate.

*Figure 2. Crucifer flea beetle.*

Light to moderate infestations delay plant development and cause uneven maturity. Delayed maturity may expose the crop to adverse temperatures during flowering or to frost before the plants have matured. Uneven maturity at harvest reduces seed quality or yield. Delaying harvest to allow immature pods to ripen contributes to yield loss when over-ripe seed pods shatter during harvest. Harvesting too early produces a crop with many immature seeds containing high chlorophyll levels, affecting seed quality and yield. Most of this damage can be prevented if canola is protected from flea beetle injury during the two to three weeks following emergence.

During summer months, the larval stages of flea beetles contribute to yield losses by feeding on plant roots and root hairs. Root damage is estimated to reduce yield by about five per cent.

Flea beetles which emerge after mid-July can also affect yield. Their feeding during pod development and filling causes injury to seed pods, leading to premature pod drying, shriveled seeds and pod shattering, and encourages fungal growth within the pods during damp weather. Injury to the seed pods is usually concentrated on the youngest pods and on late-seeded crops.

**Life Cycle and Identification** The life cycle of the crucifer flea beetle is summarized in Figure 3.

**Adults:** Flea beetles attacking canola, mustard, and rapeseed are small, elliptical or oval shaped beetles less than 2.5 mm long. When disturbed, they use their powerful hind legs to jump away, hence the name flea beetle. The crucifer and striped flea beetle are the dominant species feeding on these plants.

The crucifer flea beetle is the most widely distributed and destructive flea beetle attacking canola, mustard, and rapeseed. Adult crucifer flea beetles are uniformly black with a metallic bluish sheen (Figure 2). The wing covers (elytra) are randomly punctated and the large hind legs (tibia) are a dark amber colour.

The striped flea beetle is less abundant except near the northern edge of the agricultural region in Canada. Adults are black with distinctive yellow stripes on their elytra (Figure 4).

Each species has a single generation per year, although adults appear twice during the growing season. In the spring, over-wintered adults emerge and feed on canola seedlings. In the fall, it is the offspring of the overwintering adults that are observed feeding on canola leaves, stems and seed pods.

## Flea Beetle Life Cycle

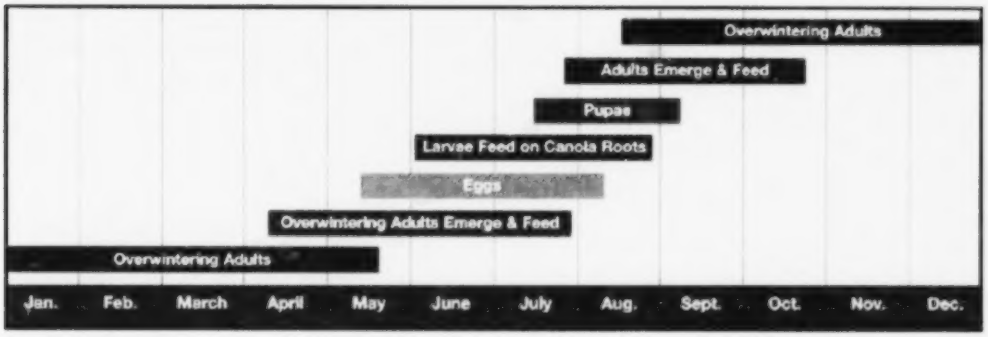


*Figure 3. flea beetle life cycle.*

Flea beetles over-winter as adults within leaf litter, grass, and debris beneath hedges, shelterbelts, poplar groves, and in association with canola stubble and volunteer cruciferous plants. Within the leaf litter, flea beetle densities may be as high as 140 to 250 beetles/$m^2$.

*Figure 4. Striped flea beetle.*

The leaf litter begins thawing in the spring between late April and early May, but it will take another five to 11 days before the first flea beetles become active. Depending on temperature, it may take an additional three weeks before all the overwintering adults leave the over-wintering sites. The striped flea beetle adults begin emerging slightly before those of the crucifer flea beetle.

Under cool conditions, flea beetles walk or hop into the adjacent cruciferous crops or weeds where they cause severe damage to seedlings. When temperatures exceed 14° C (early to mid-May) and wind is calm, the adult beetles may take flight and invade other fields, attacking seedlings as they emerge.

After selecting a host plant and feeding has commenced, beetles mate repeatedly. Egg-laying begins in mid to late May, and continues until the end of June, or for about 30 days. A very small proportion of the population may continue to lay eggs until early August.

**Eggs:** Egg deposition begins in late May and continues throughout most of June. Females deposit about 100 smooth, yellow, elongate, oval eggs (0.38 - 0.46 mm by 0.18 - 0.25 mm wide), either singly or in groups of three or four, in the soil adjacent to the host plant's roots. Unless the eggs are in contact with moist soils, they desiccate within a few hours. The eggs take about 12 days to hatch.

**Larvae:** Flea beetle larvae are grub-like with off-white bodies and a brown head and anal plate. Larvae moult twice during the 25 to 34 days it takes them to complete three larval stages. Larvae feed on the root hairs and taproots of seedlings. In a few cases, larvae have been observed burrowing into the plant near the juncture of the root and stem. When larval development is complete, larvae pupate in small earthen cells.

**Pupae:** Flea beetle pupae are usually present in the field by early to mid-July. They are entirely white except for the eyes, which darken as the pupal stage progresses to completion. The body appendages are free and distinguishable. The pupal stage lasts for about seven to nine days.

**Adult:** Adult emergence begins after mid-July and continues until early September. The beetles feed on the leaves, stems and pods of cruciferous plants. Development from egg to adult takes about seven weeks. In late August and September, adults move into leaf litter and debris to over-winter.

## Crop Damage

Flea beetles injure plants by feeding on leaf tissue, stems and pods. When feeding is extensive, the small feeding pits merge and form larger holes in the leaves. If temperatures are cool in the spring, flea beetle feeding may be more prevalent closer to the soil surface, resulting in girdling of the young stems.

During seedling emergence, severe stand loss can occur if flea beetle populations are high and the cotyledons are the only green tissue available. Crop thinning and growth rate reduction caused by flea beetle feeding are most severe the first two weeks after seedling emergence. Early damage to seedlings produces plant stands with uneven height and maturity, reduced seed yield, and contributes to seeds with elevated chlorophyll content.

In the fall, the adult population feeds on seed pods, making them prone to shattering and contributing to the production of small seeds and seeds with increased chlorophyll content.

## Monitoring

In the fall, flea beetle densities should be noted. This will be the producer's first signal of potential problems next spring. If flea beetles are abundant, the use of insecticides at planting should be seriously considered.

In the spring, producers should monitor and assess damage to cotyledons and the first true leaves on canola, rapeseed and mustard seedlings for the first 14 days after emergence, especially on sunny, calm days when temperatures exceed 14° C.

## Pest Management

The flea beetles can locate, attack, and quickly injure or destroy seedlings shortly after emergence, making them extremely difficult to control. To manage flea beetles, producers should use a combination of cultural and chemical control strategies.

## Biological Control

Predators, parasites and diseases can be important in regulating insect populations. To date, the effect of biological control agents seems to be limited, but several insects have been observed attacking adult flea beetles.

Lacewing larvae (*Chrysopa carnea*), big-eyed bugs (*Geocoris bullatus*), the two-lined collops (*Collops vittatus*), the western damsel bug (*Nabis alternatus*) and the northern field cricket (*Gryllus pennsylvanicus*) are a few of the insects known to prey on flea beetles.

The native braconid wasp (*Microctonus vittatae*) parasitizes flea beetle adults. However, its overall effect on flea beetle populations is unknown.

Unfortunately, flea beetle populations emerge in large numbers during a relatively short period of time, and tend to overwhelm the parasites and predators.

## Cultural Control

The larger the seedling, the more it can withstand injury from flea beetle feeding. To obtain large plants early, producers should use good quality seed and plant as shallowly as available moisture will allow. This produces seedlings that germinate and emerge quickly and grow vigorously. Seedlings of vigorously growing varieties are able to tolerate flea beetle feeding more than seedlings of less vigorous varieties.

Until recently, few post-emergent broadleaf herbicides were available, resulting in delayed seeding. However, with the advent of herbicide-tolerant canola, producers have the option of seeding early and controlling a broad spectrum of weeds with post emergent herbicides.

If early seeding is used in conjunction with direct seeding into standing stubble, plants are afforded a micro-climate that offers moist soil conditions (favouring rapid germination). Seedlings established early under cold conditions appear to be more tolerant to frost than those established late under warmer growing conditions. Although average soil temperatures are not considerably different from those on conventionally cultivated fields, they are not subjected to extreme fluctuations observed in fields where crops are grown under conventional practices. Flea beetles have a preference for environments that are exposed to bright sunlight and are relatively warm. Direct seeding provides a micro-climate which is less ideal for flea beetles.

This seeding method produces large plants early and may reduce the producer's dependence on seed treatments and foliar insecticides, except under conditions of intense flea beetle pressure.

Increasing seeding rates can help reduce the impact of flea beetle attack. For a given population of flea beetles, having more plants per unit area means that feeding damage per plant is reduced and seedlings can then recover more readily from flea beetle injury.

At a given seeding rate, wider row spacings of 20-30 cm, rather than 10 cm, can also result in less flea beetle damage per plant. Although the reasons are not yet clear, it appears that flea beetles are more attracted to the reduced visual contrast between vegetation and soil that occurs at narrow row spacings.

Crop rotation is not an effective means of controlling flea beetles; adults over-winter inside and outside of the cropped areas and are capable of long range migration.

## Chemical Control

**Seed treatments**: Coating seeds with an insecticide in combination with one or more fungicides prior to planting is a common practice. With the seed treatments currently available, canola seedlings are protected from flea beetles as soon as the plants emerge. Registered seed treatments must be applied by commercial seed treaters with appropriate licensing and facilities.

The seed treatments currently available for control of flea beetles in canola come with the insecticide at either a lower or high rate. The high rate is more expensive than the lower rate, but has an extended period of protection from flea beetles relative to the lower rate. These insecticides are systemic within the plant, and the flea beetles must feed on the plant material to receive a lethal dose.

Research is currently underway on additional seed treatments for flea beetle control in canola.

**Foliar insecticides**: A post-emergent insecticide application may be required to protect seedlings which are not grown with a seed treatment or are exposed to severe or prolonged periods of intense attack. When canola is seeded without a seed treatment containing an insecticide, field scouting for flea beetles is important, particularly on hot, calm days. If heavy flea beetle damage or high numbers of flea beetles are noticed in the field, foliar sprays must be applied as soon as possible, since flea beetles can rapidly cause substantial damage. Additional foliar sprays may sometimes be needed, since flea beetles may continue to move into fields of canola at the susceptible stage after the residual from the first foliar spray has become ineffective.

**Economic Thresholds**: Economic thresholds are needed to decide whether a foliar spray for flea beetle control will be an economical investment. Since control decisions are made prior to seeding when seed treatments are used, the use of economic thresholds for flea beetle control in canola applies when foliar sprays are used as a primary flea beetle control strategy or if high feeding pressure continues.

Canola seedlings can often withstand 50 per cent leaf loss. Flea beetles can damage plants very quickly, however, so the economic threshold for flea beetle feeding on canola is when there is 25 per cent defoliation and flea beetles are present. Applying controls at 25 per cent defoliation will reduce the risk of flea beetle damage getting to the level where yield loss and plant development have been substantially reduced.

When scouting fields for flea beetle damage, realize that flea beetles generally invade canola fields from the field edges. Flea beetle damage and numbers of flea beetles may be higher at the field edge than farther into the field. If this appears to be the situation, a foliar spray around the field edge may provide sufficient protection. On hot and calm days, flea beetles are capable of moving farther distances and may populate the field more uniformly.

When assessing economic thresholds, it is often important to consider growing conditions as well. When flea beetle feeding is combined with poor plant growth during hot, dry weather, canola can tolerate less flea beetle feeding than if plants are growing under more ideal growing conditions.

Refer to the current edition of the Guide to Crop Protection for insecticides registered for control of flea beetles.

## Conclusions

Currently, insecticides applied with the seed (seed treatments) are the preferred strategy to provide protection from flea beetles in areas which have a persistent history of high flea beetle damage. When high populations are present, the speed at which flea beetles can destroy plant stands makes the reliance on post-emergence applications of insecticides risky.

Research is currently being performed to try to develop flea beetle resistant varieties of canola. If successful, this may be another option available to canola growers in the future for flea beetle control.

Other potential advances in canola production, such as fall-seeded canola, and varieties and weed control programs that allow for earlier seeding, may also help to make flea beetles less of a risk on canola.


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For more information about flea beetle management, contact the local representative of the appropriate agency. In Saskatchewan,

- Contact the Agriculture Knowledge Centre toll free at 1-866-457-2377.